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"DEMAND ANALYSIS AND DEMAND PROJECTIONS OF FOOD ITEMS IN INDIA– AN ECONOMETRIC ANALYSIS"

(1) Introduction

During planning period the structure of Indian economy has undergone substantial changes. There was also changes took place in the consumption pattern due to rise in income levels and changes in the composition of income distribution. The significant changes in the all sectors of the economy have a direct impact on the welfare of the people. Economic development results in increased levels of income and consumption; equally important, it brings about a change in the socio-economic attitudes and even in the general outlook of the people. This, in turn, changes the level and pattern of consumption by people. A notable change in the pattern of consumption expenditure is expected due to change in per capita income. The pattern of expenditure is a good indicator of the economic status and the standard of living of the consumers and also shows the relative importance of individual items in the consumption basket.

Generally, compared to the Total Consumption Expenditure, the Per Capita Consumption Expenditure gives the real standard of living of the population. So, monthly per capita expenditure (MPCE) is one of the important indicators of the status of general economic development of a nation. It is also one of the important components used for calculation of poverty ratio, and data on monthly per capita consumption expenditure of different states are also useful for making comparison between development processes of the different states in country. Engel's ratio, which speaks about the ratio of expenditure on food and non-food items, is a well-recognized indicator of the standard of living of people.

Knowledge of demand structure and consumer behaviour is essential for a wide range of development policy questions like improvement in nutritional status, food subsidy, sectoral and macroeconomic policy analysis, etc. An analysis of food consumption patterns and how they are likely to shift as a result of changes in income and relative price is required to assess the food security-related policy issues in the agricultural sector.

This analysis is based on a matrix of price and income elasticities of demand for food groups. In the short run, with relatively inflexible production, changes in the structure of demand are the main determinants of observed changes in market prices for non-tradable goods and of imports and exports of tradable goods. In medium and long runs, the structure of final demand is an important element of more complete models that seek to explain the levels of production and consumption, price formulation, trade flows, income levels and government fiscal revenues.

(2) Review of Literature

A review of available literature as related to the subject is an important and integral part of any research study. A critical survey of the literature on the subject will help in framing the aims objectives and methodology.

- **A.S.M. Anwarul Huq et. al. (2008)** had calculated the demand elasticities for different food items in Bangladesh by using the AIDS (Almost Ideal Demand System) model. The data pertaining to the expenditure on different food items were collected from Household Expenditure Survey (HES) during the year 2005-06, 2000, 2995-96, 1991-92, 1988-89 and 1983-84.This survey was undertaken by Bangladesh Bureau of Statistics (BBS). Prices of different food items are divided by the respective year's Consumer Price Index (CPI) to convert them into real term. The linear approximate almost ideal demand system (LA/AIDS) model was chosen to estimate the parameters of food demand in Bangladesh. Anwarul Huq had concluded that almost all food items had a positive income elasticity of demand signifying that are normal goods. On the contrary edible oil, fish, meat, fruit, milk and spices were expenditure elastic for which these could be considered as a luxury while cereal, pulses and vegetable were income inelastic indicating that those were necessities. The compensated and uncompensated own price elasticity indicate that all food items except edible oils and spices were price inelastic. The cross price effects had no clear direction and a relatively low degree of complementarities and substitutability existed among the food items considered in the model. There were no systematic differences found in the absolute magnitudes of expenditure elasticity and own price elasticity. It showed that combination of income and

price policies may be more effective in influencing consumption pattern than those based solely on one and not the other.

- **Shurbhi Mittal (2006)** had made the demand projection of food items for the year of 2020. This study utilized data from National Sample Survey Organisation for the year of 1983, 1987-89, 1993-94 and 1999-2000, respectively. The different elasticities were calculated by using the AIDS model. The study concluded that the expenditure elasticity of food items fall as we moved from rural households to urban households. The expenditure elasticity for cereal was found to be very low but had a positive sign. It is around 0.2. For pulses, the expenditure elasticity slightly declined. On the other hand the expenditure elasticities for milk and meat, fish and eggs are greater than one and for sugar and vegetables and fruits they are very high. The demand projections had been made by using the elasticities as derived from the AIDS model. Demand projection for food items concluded that if the economy grew at 7 percent, the total foodgrain demand will be 194.3 MT. with breakup of 175.5 MT of cereal demand and 18.8 MT of pulse demand in 2010. This demand is expected to rise at a rate of 2.1 per cent and 3.3 per cent, respectively between 2010 and 2020. In 2020 the projected domestic demand is 215.7 MT and 27.2 MT for cereal and pulses, respectively.

- **Abdulai et.al, (1999)** had used Linear Approximate Almost Ideal Demand System (LA/AIDS) to estimate food demand for India. The study discussed the need to use demographic variables, such as, region, household size, education level, religion, and seasonality in estimating food consumption in India. Past studies have used aggregate household consumption data to estimate food demand in India due to non-availability of micro-level data. The objective of this study was to show that factors other than price and expenditure might be used to yield substantially greater precision in the estimation of demand parameters. The study estimated separate food demand for urban and rural population using household consumption survey data. The commodity groups used in the study were: milk and milk products, cereals and pulses, edible oils, meat, fish, and eggs, fruits and vegetables, and other foods. Demographic effects are incorporated in the model allowing the intercepts in the budget share equations to be a function of demographic variables. The results showed that all goods were normal since all expenditure elasticities

were positive. The commodity groups that had expenditure elasticities less than one in rural and urban areas include cereal and pulses, edible oils and vegetables, and other foods. The expenditure elasticities for milk and milk products were found to be greater than one in rural and urban areas. All estimated compensated own price elasticities were negative and ranged between -0.43 and -0.74 for rural areas and -0.46 and -0.74 for urban areas. Interestingly, compensated cross price elasticities between cereals and pulses and milk and milk production are found to be negative in rural area suggesting a complimentary relationship between the food groups. However, in both rural and urban areas, the cross-price elasticities were positive, suggesting a substitution effect between groups.

- **Saha Somesh (1980)** had estimates the Engel elasticities for 101 items of consumption separately for rural and urban India using NSS budget data. Iyengar's (1960-64) method of estimation based on the use of generalized concentration curves had been used along with method of weighted least squares for finding Engel elasticity of items. The estimate seems to vary, though slightly, from one method to the other. However the ordering of commodities on the elasticity scale is found to be approximately the same by all methods. An inter-temporal comparison of elasticities over three different NSS rounds found the Engel elasticity to be more or less stable across NSS rounds.

- **Stone Richard (1954)** had analysed the pattern of demand for consumer's goods relating to United Kingdom over the years 1920-1938 on the basis of annual data. Investigation on different groups of consumer’s expenditure, quantities bought and prices paid were conducted. To analyse demand the study has applied Linear Expenditure System, which is compatible with three conditions imposed on demand systems. i.e. (i) additivity, (ii) homogeneity and (iii) symmetry. The analysis of a system of size commodity group, among which the total of consumer's expenditure per equivalent adult has been divided, is provided.

On the basis of above reviews we can say that in most of the study the expenditure elasticity had been estimating through OLS method and AIDS model. The AIDS model is more popular for deriving the different types of elasticity. Very few studies have used

panel regression model to estimate expenditure elasticities using fixed and random effect techniques, hence fixed and random effect model of panel regression model is used for estimating the expenditure elasticity.

(3) Objectives of the Study

The study has been undertaken with the following major objectives;

(i) To examine the trends in the consumption of important food items in India.

(ii) To study the significant differences in the consumption patterns across different income groups and between rural and urban areas of India.

(iii) To calculate the own and cross elasticities of demand for major food items in India.

(iv) To estimate the food budget elasticities of major food items in India.

(v) To estimate the expenditure elasticities of major food items in India.

(vi) To makes projections for demand of major food items in India.

(vii) To examine the gap between projected demand and supply of major food items in India.

(4) Data Sources

The study utilizes the secondary data for evaluating and analyzing the specific objective of the study. Data on Monthly Per Capita Expenditure (MPCE) has been collected from various round of National Sample Survey Organization (NSSO) published by GOI. The data on physical quantities on selected food items were available only from 50^{th} round (1993-94) onwards. In the present study the data on Monthly Per Capita Consumption of various food items in monetary term and physical term had collected from 55^{th} (1999-2000), 61^{st} (2004-05) and 66^{th} (2009-10) rounds. The data of various food items prices were calculated by dividing the value in physical term to value in monetary term of monthly per capita consumption. For the estimation of future supply situation of selected food items we have collected the data regarding to area under cultivation, production and productivity of selected food items from Agricultural Statistic at a Glance, Directorate of Economics and Statistics, GOI Publication.

(5) Research Methodology

There were several methods used in this study entitled "Demand Analysis and Demand Projection of Food Items in India – An Econometric Analysis". For deriving the price and cross elasticities the demand function has been used. The Income Elasticity (Expenditure Elasticity) is determined by using panel regression approach and at last by using the income elasticity the demand projection has been made by using demand projection model.

The AIDS model derives from a utility function specification as a second order approximation to any utility function. The demand functions are derived in the budget share form. Deaton and Muellbaure (1980) suggested approximating the price index P by the stone geometric price index;

$$LnP^* = \sum_i w_i \, lnP_i \ldots\ldots\ldots \quad (1)$$

This linear approximation is all the better if there is collinearity in prices over time.

This price index used for calculating the price and cross elasticities of demand from the demand parameters derived from QUAIDS model. This model is as follows;

Estimation method of demand parameters: Quadratic AIDS (QUAIDS) Model

This model is quite popular and was adopted by Meenakshi and Ray (1999) for India food model, Dey (2000) for fish demand model of Bangladesh and Kumar (2004) for fish demand model in India. The specific functional form for ith item/groups is as follows;

$$S_i = \alpha_i + \sum b_{ij} Ln(FP_i) + c_{oi} Ln(M/I) + c_1 i(LnM/I)^2 + d_t \, URBAN + \sum e_{ik} IMR_k \ldots. \quad (2)$$

Where Fpi is the price of ith item/groups; I is the Stone Geometric Price Index; URBAN is a binary dummy variable for urban areas. The parameters of the model (ai, bij, ci, di and eik) will beestimated by imposing the homogeneity (degree zero in prices), symmetry (cross price effects are same across the good), and adding up (all the budget shares add up to one) restrictions. The following restrictions were econometrically imposed.

Homogeneity; $\sum_{j=1}^{n} bij = 0;$

Symmetry: $b_{ij} = b_{ji}$, $c_{11}/c_{10} = c_{21}/c_{20} = \ldots \ldots cn_1/cn_0$

Adding up : $\sum \alpha i = 1$, $\sum_i cio = \sum_i bij = \sum_i di = 0$

The homogeneity and symmetric restrictions are imposed at the sample mean. Adding up restriction is imposed while computing the parameters of the last equation of the model, which is not included in estimation. Given the quadratic specification of the demand system (Equation (1) and (2)) a test of symmetry additionally requires that the ratio of the coefficients on the food expenditure and the share terms in food expenditure be the same for all items/groups (Blundell et al 1993). The predicted value of food expenditure obtained from stage 1 will be uses as the explanatory variable. The income and price elasticity can easily be computed as follows;

$$\eta_i = (c_{i0} + 2c_{i1}Ln(F)/w_i) + 1 \ldots\ldots\ldots\ldots\ldots \quad (3)$$

Uncompensated Price Elasticity

$$\xi_{ij} = b_{ij}/w_i - (c_{i0} + 2_{i1}Ln(F)(w_j/w_i) - k_{ij} \ldots\ldots\ldots\ldots \quad (4)$$

Where k_{ij} is kronecker delta, which takes the value of one for own price elasticity and zero for cross price elasticity; and w_i is the share of the ith items/groups used as a weight in constructing Stine's price index. Once the expenditure and uncompensated price elasticities are estimated, the compensated own and cross price elasticities are computed using the Slutsky equation in elasticity form:

$$\xi_{ij}^{H} = \xi_{ij} + w_j\eta_i \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Where, ξ_{ij}^{H} is the compensated (Hicksian) price elasticity.

The price, cross and expenditure elasticities were calculated separately for very poor, poor, non-poor and rich class families. The classification of different class of families is based on the recent poverty line criteria in rural and urban area. The criteria of different class of families as is follows;

Very Poor :- Monthly Per capita Consumption Expenditure (MPCE) is More than 75% and less than poverty line

Poor :- MPCE is Between Poverty line and Above the line of very poor

Non-Poor :- MPCE is Less than 150% and more than poverty line

Rich :- MPCE is more than Non-Poor class

The expenditure elasticiteis were also calculated from the food budget elasticity which derived from QUAIDS model. But in this study we have used the panel regression approach to derive the expenditure elasticities of different food items. The model is as follows;

Panel Regression Model

In the present the data are usually collected over time and over the same states. The regression is run over these two dimensions. Panel regression analysis is a multidimensional analysis.

A common panel data regression model is as follows;

$$MPCEFxst = \alpha + \beta MPTCEst + \epsilon st \quad \ldots\ldots\ldots\ldots\ldots \quad (6)$$

Where *PMCEFxst* = Monthly Per Capita Consumption Expenditure on food item x for state s……n and for the year t……..n; $MPTCEst$ = Monthly Per Capita Total Consumption Expenditure for state s……n and for the year t……..n. α, β and ϵ are the parameters of model.

Panel data analysis has three more-or-less independent approaches:

1) independently pooled panels;
2) random effects models;
3) fixed effects models or first differenced models.

1) Independent Pooled Panel Regression:

Independent Pooled Panel regression model is assumed that the co-efficient of the model is same within each unit (in our study this unit is each state). Therefore we can say that Pooled panel regression model is simply like OLS model.

2) Fixed Effect Regression Model:

Fixed effect regression model explore the relationship between predicator and outcome variables within an entity (in our study this entity is state). This model gives the predicators' net effect. The fixed effects model is as follows;

$$MPCEFxst = \beta_0 + \beta_1 MPTCEx_1, st + \ldots + \beta k MPTCEx_k, st + \gamma_1 E_1 + \ldots\ldots + \gamma_n E_n + u_{st} \ldots (7)$$

Where,

$MPCEFxst$ = is the Monthly Per capita Total Consumption Expenditure on Food item of x for s state and t time.

$MPTCEst$ = Monthly Per Capita Total Consumption Expenditure for state s……n and for the year t……..n

βk = is coefficient food items x_i….n

u_{st} = is the error term

E_1 = is the state n. since they are dummy you have n-1 states included in the model.

γ_n = is the coefficient for the dummies repressors.

The important assumption of this model is time invariant characteristics are unique to the individual and should not be correlated with other individual characteristics.

3) Random Effect Regression Model:

The random effect model has been used in this study when the differences across different states have some influence on the dependent variable (Consumption expenditure on different food items). The random effects model is;

$$MPCEFxst = \beta_0 + \beta_1 MPTCEx, st_ + u_{\underline{st}} + \varepsilon_{\underline{st}} \ldots\ldots\ldots\ldots \quad (8)$$

Where, u_{st} is explain the between state error and εst is within state error.

Random effects model assumed that the states' error term is not correlated with the predicators which allows for time-invariant variables to play a role as explanatory variable.

From the above models, which model is better model for our data set is selected by using different statistical tests like Joint test, Breusch-Pagan test and Hausman test. The joint test is used for the selection of panel regression model from pooled OLS model and fixed effect model. The Breusch-Pagan test is used for the selection of panel regression model from pooled OLS model and random effects model and Hausman test used for the panel regression model selection between the fixed effects model and random effects model.

The expenditure elasticities which derived by using Panel Regression approach have been used to demand projections of these food items.

The demand projections for the commodities are obtained through

$$D_t = d_0 * N_t(1+y*e)^t \quad \ldots\ldots\ldots \qquad (9)$$

Where d_t is household demand of a commodity in year *t*'

D_0 = is per capita demand of the commodities in the base year,

y = is growth in per capita income,

e = is the expenditure elasticity of demand for the commodity;

N_t = is the projected population in year t.

Further, the supply projection has been made using a straightforward approach. Supply projections have been calculated assuming the yield growths to be same as in the past decade. It is also assumed that further area expansion will take place.

The following formula has been used for supply projection;

$$Y_t = Y_0 * (1+r)^t \ldots\ldots\ldots\ldots\ldots\ldots \qquad (10)$$

Where, Y_t = Year of Projection of harvest area or yield of food items,

Y_0 = yield of food items in base year,

r = average annual growth of harvest area

t = numbers of years under projection

After the calculation of projected harvest for food items area and yield of food items, both projected values has been multiplied for calculate the projected production of specific food items.

(6) Chapter Scheme:

The chapter scheme for the study as under:

Chapter-1 : Introduction

This chapter is divided in three sections. In this study for deriving the demand parameters and demand projections we have used data on monthly per capita consumption expenditure on different food items. Therefore in the first section of this chapter we have tried to give the brief introduction about the consumption function theories and consumption pattern in India. In the second section, we have discussed about the some of the basic concepts of demand theory and linear expenditure system. The research methodology covered in the last section of this chapter.

Chapter-2 : Review of Literature

In the second chapter of this study we have reviewed the related literature of our study area. The review of literature done in three different parts namely reviews of literature on international level, national level and regional level studies.

Chapter-3 : Price and Cross Elasticities of Demand

The price and cross elasticities which we have derived by using the Ordinary Least Square (OLS) and Quadratic Almost Ideal Demand System (QUAIDS) models discussed in this chapter. This chapter divided in three sections. The first section dealt with the demand parameters. In the second section we have calculated the compensated and uncompensated price and cross elasticiteis by

using the Hicks and Slutsky methods. In the last section of this chapter the food budget elasticites are derived.

Chapter-4 : Expenditure Elasticities and Demand Projections

In this chapter we have estimated the expenditure elasticities of different food items by applied the panel regression approach. The expenditure elasticiteis further used for demand projections of different food items. For understanding the future situation of demand and supply gap of different food items, we have also predicated the future supply situation.

Chapter-5 : Conclusions and Suggestions

The conclusions of this study are covered in this chapter. On the basis of results and conclusions we have try to give few suggestions to policy making regarding the major food items' production and supply.

(7) Data Analysis and Conclusions

(1) The results of uncompensated and compensated own price elasticities of major food items shows that, excepting milk the own price elasticities of different food items is less in compensated criteria than uncompensated criteria for both rural and urban areas of India. In the case of milk, the own price effect is noted to be higher under compensated criteria than uncompensated.

(2) Compared to the urban area, the rural area is more affected by the change in prices of different food items excepting food oil and MFC. The notable price effect is found for milk consumption, in rural area the own price effect is almost more than -4.04 but in urban it was registered to the -0.24. So we can say that in rural area livestock is a main occupation with agricultural activities therefore when price of milk is increased they trying to sell more milk by more reducing their self consumption also. However urban people relatively give the higher preference to the milk consumption in their food basket.

(3) At all India Level (R+U), the expenditure elasticity had found to be greater than one for milk and vegetables. The lowest expenditure elasticity is noted for cereals and highest for milk. The coefficient of urban dummy is found to be significant for cereals, pulses, food oil, vegetables and sugar and these coefficients are positive.

(4) The expenditure elasticity of cereals had found to varied high to low from very poor class families to poor class families. In the case of rich class families expenditure elasticity of cereals had found to be negative which implies that with increased in the total expenditure the share on cereal consumption had decreased by rich class families. This share is increased by the greater proportion by very poor class families than poor and non-poor class families.

(5) The projected demand for various food items in rural areas indicates that the demand will be increased upto 2021 in quantity term but after 2021 the demand will declined. In term of percentage change in projected demand for various food items, according to actual and high rate of growth assumption the demand for various food items will increased upto 2021 then it will tends to decreases. However if we assume the low per capita income growth, the demand for cereals, milk and sugar well be increased upto 2041, then it will be declined. But the projected demand for pulses, food oil, MFC and vegetables will increased during the projected years but at decreasing rate.

(6) On the other hand the projected demand for various food items in urban areas shows that due to high urbanization the demand for various food items will increase rapidly. But due to decline in the growth rate of total population and low elasticity of demand for various food items the demand will be increased at decreasing rate. The notable points we have observed in the demand projections for various food items in urban area is that if we assume the high per capita income growth, the projected demand will be increased over a period of time in future but it increased less than increased under the assumption of actual and low

per capita income growth, it is due to the low expenditure elasticity of various food items in urban area.

(7) The projected supply of various food items were done under the two scenarios, under first scenario (If Area harvesting Growth is 3.26%) the supply of cereals estimated to 350.23 million metric tons in 2021, which will increased and reach to 438.78 million metric tons in 2051. The pulses, sugar, food oil and vegetables supply is estimated to about 30.86, 61.45, 12.27 and 283.86 million metric tons in 2021 respectively which will increased and reached to 68.26, 101.98, 27.28 and 826.29 million metric tons in 2051 respectively.

(8) If we examine the gap between demand and supply according to first scenario, accepting the sugar there will be deficit in availability of various food items. The demand and supply gap of cereals will be expected the 85.94 million metric tons in 2021 which will reach to 185.02 million metric tons in 2051. This gap for pulses, food oil and vegetables will be expected to 18.67, 58.4 and 79.31 million tons in 2051 respectively. Expecting cereals and food oil, the future gap of demand and supply will decreases. It may be due to decrease in the future population growth rate in India.

(8) Limitations of the Study

(1) The models used in the study are based on simplistic assumptions which may not be entirely valid for India and for the time period under consideration.
(2) Several other influencing factors have not be taken into account considering the paucity of time and availability of data. To that extent the conclusions derived from the study will be affected
(3) The study utilized secondary data given that there are ambiguities changes in definitions and concepts over a time period, the results derived may be affected to that extent. However, it is hope that broad conclusions may still remain valid.

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